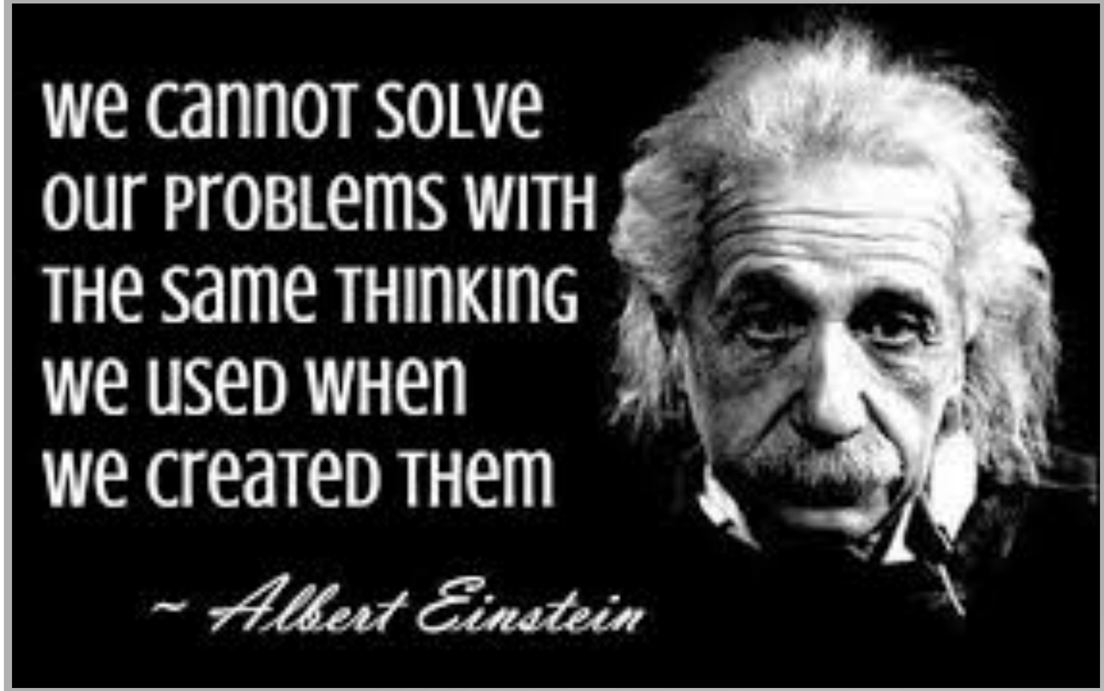
Next Generation Science Standards

Introduction for SBCSS
Linda Braatz Brown

NGSS adopted Sept. 4, 2013



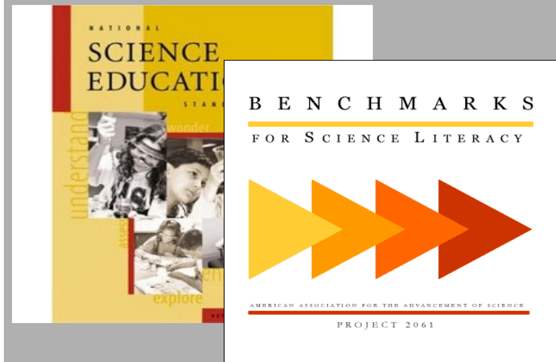
Why New Standards?

- Economically:
  - Past 10 years growth in STEM jobs was 3 times greater than non-STEM jobs
  - Shrinking share of patents: foreign competitors files over half of US technology patent applications in 2010
  - Diminishing share of high-tech exports – European Unions high tech exports held steady and China's has surpassed the US
- Academically:
  - Past 15 years, students' achievement in science remained stagnant; no more than 30% of students meeting proficiency mark for NAEP. Same % of students at "below basic" level
- Internationally:
  - Number of countries scoring higher that US on science assessment rose from 6 to 12

- Major advances in Sciences:
  - Science breakthroughs
  - Better understanding of how students learn science effectively
  - Increase importance on critical thinking, creativity, collaboration and communication: 21st Century skills
  - Need to not only know science concepts, but their engineering aspect (solving a problem)

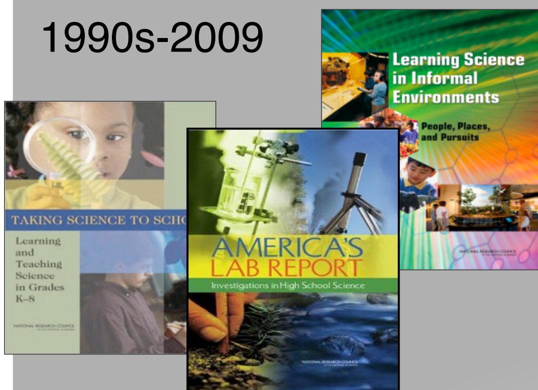
Source:http://www.nextgenscience.org

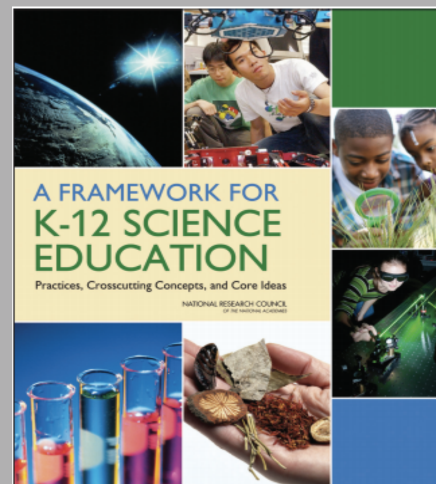
Why new standards?



1990s

1990s-2009





1/2010 - 7/2011

NEXT GENERATION SCIENCE STANDARDS

For States, By States

Building on the Past; Preparing for the Future

- Content focuses on fewer ideas to be developed in depth
- In teaching, scientific and engineering practices will be tightly tied to content and cross cutting concepts
- Scientific modeling, communication, argument and social interaction are recognized as central practices in science and engineering
- Asking researchable questions, defining problems, designing investigations and making meaning of results will be emphasized

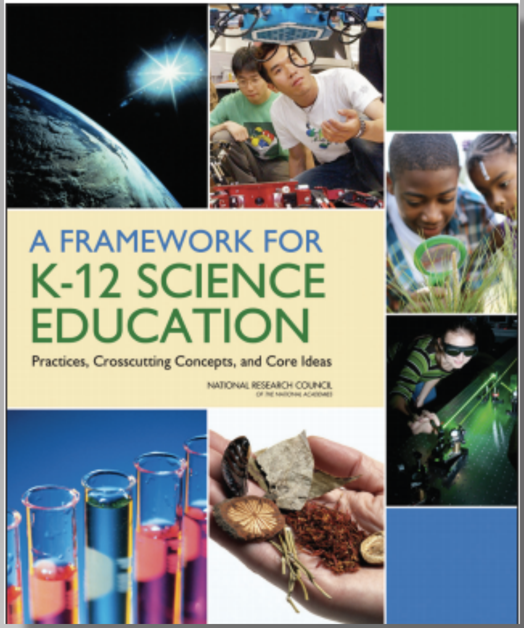
Major Shifts

Old Science	New Science
Remember – 64%	Remember – 0%
Understand – 25%	Understand – 21%
Apply – 7%	Apply – 9%
Analyze – 2%	Analyze – 13%
Evaluate – 1%	Evaluate – 7%
Create – 1%	Create –50%

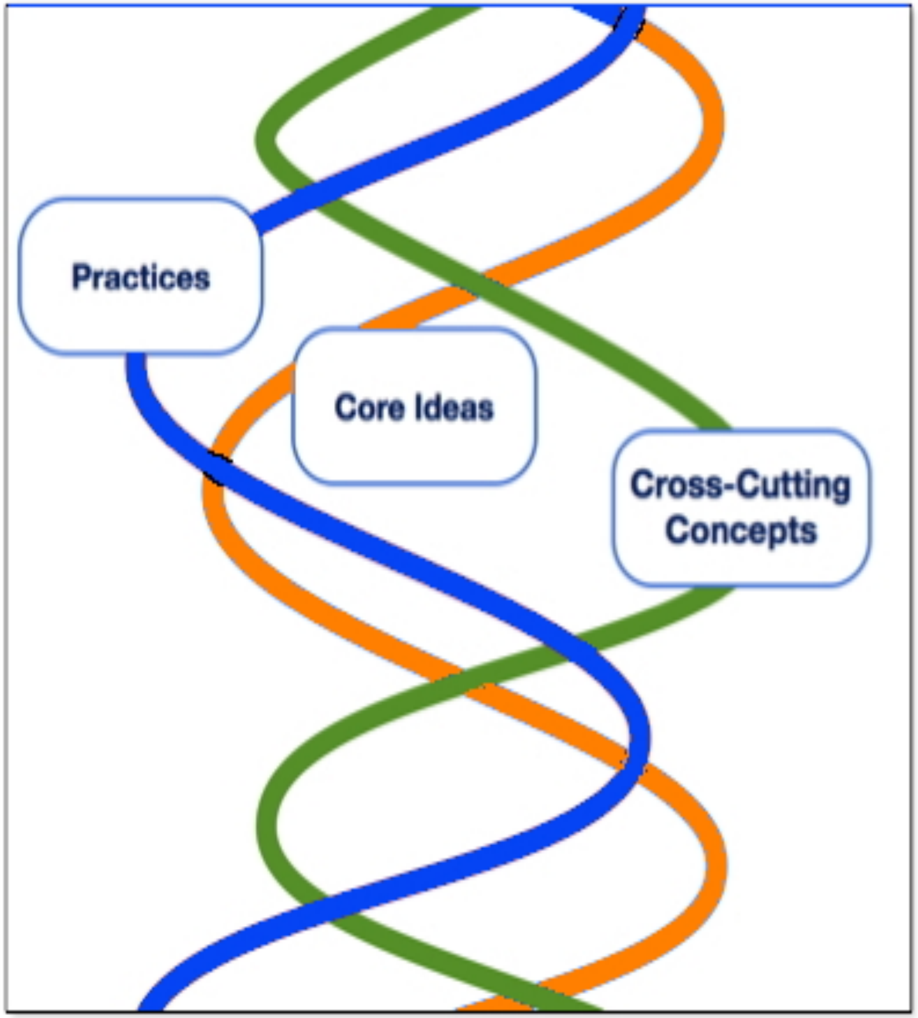
Changes in Cognitive Levels George Manthey, ACSA

Three-Dimensions:

- **Scientific and Engineering Practices**
- **Crosscutting Concepts**
- **Disciplinary Core Ideas**



A Framework for K-12 Education



- The NGSS are written as Performance Expectations
- NGSS will require contextual application of the three dimensions by students.
- Focus is on how and why as well as what

Three Dimensions Intertwined

1. Patterns
2. Cause and effect: Mechanism and explanation
3. Scale, proportion, and quantity
4. Systems and system models
5. Energy and matter: Flows, cycles, and conservation
6. Structure and function
7. Stability and change

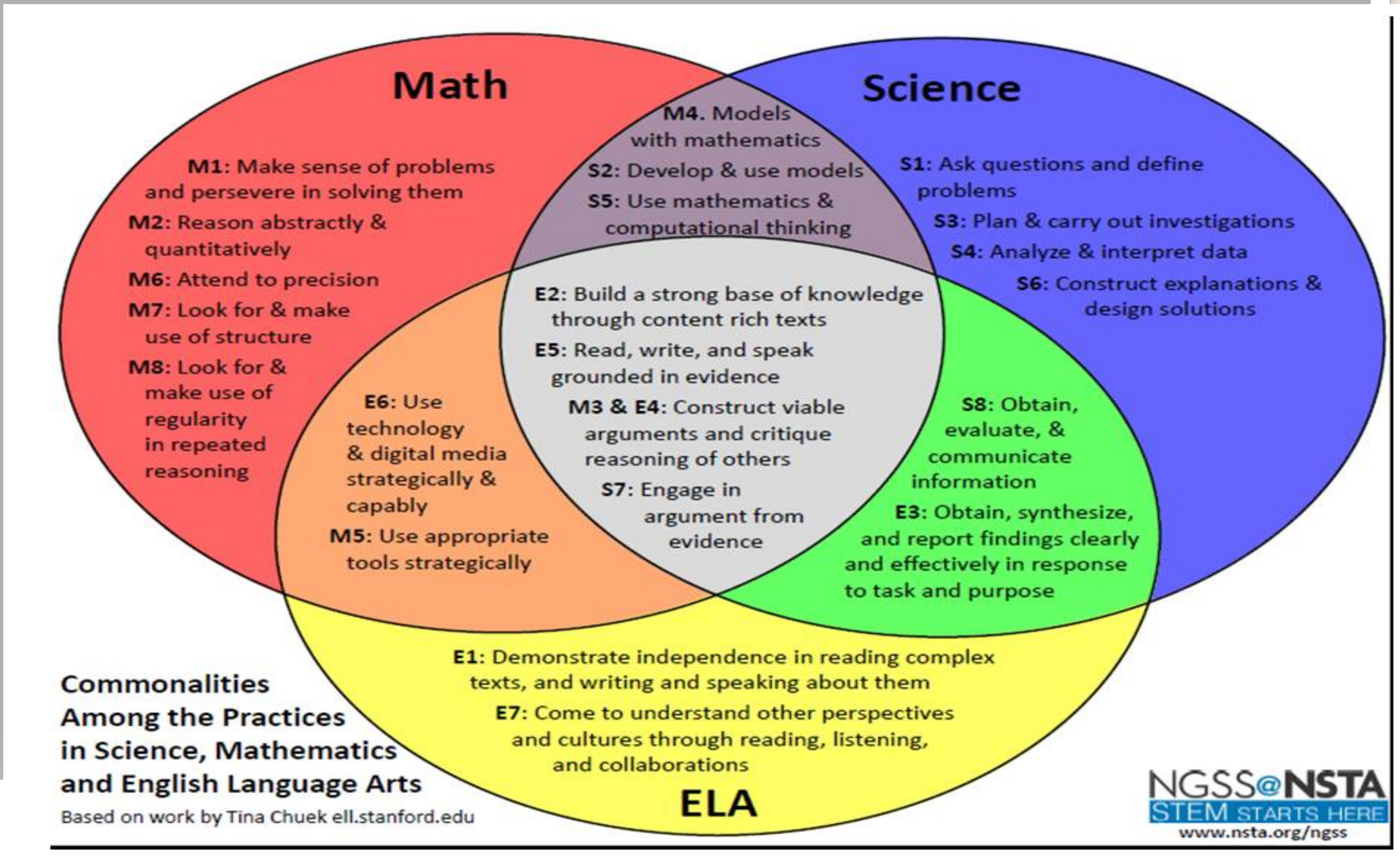
Crosscutting Concepts

Disciplinary Core Ideas

Life Science	Physical Science
LS1: From Molecules to Organisms: Structures and Processes LS2: Ecosystems: Interactions, Energy, and Dynamics LS3: Heredity: Inheritance and Variation of Traits LS4: Biological Evolution: Unity and Diversity	PS1: Matter and Its Interactions PS2: Motion and Stability: Forces and Interactions PS3: Energy PS4: Waves and Their Applications in Technologies for Information Transfer
Earth & Space Science	**Engineering & Technology**
ESS1: Earth’s Place in the Universe ESS2: Earth’s Systems ESS3: Earth and Human Activity	ETS1: Engineering Design ETS2: Links Among Engineering, Technology, Science, and Society

Engineering and technology are added for 2 critical reasons: To reflect the importance of understanding the human-built world and to recognize the value of better integrating the teaching and learning of science, engineering, and technology

Commonalities Among Practices in Science, Mathematics, and English Language Arts



Inside the NGSS Box

Title and Code

The titles of standard pages are not necessarily unique and may be reused at several different grade levels . The code, however, is a unique identifier for each set based on the grade level, content area, and topic it addresses.

What is Assessed

A collection of several performance expectations describing what students should be able to do to master this standard

Foundation Box

The practices, core disciplinary ideas, and crosscutting concepts from the *Framework for K-12 Science Education* that were used to form the performance expectations

Connection Box

Other standards in the *Next Generation Science Standards* or in the *Common Core State Standards* that are related to this standard

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3-PS2 Motion and Stability: Forces and Interactions

Students who demonstrate understanding can:

3-PS2-a. **Carry out investigations of the motion of objects to predict the effect of forces on an object in terms of balanced forces that do not change motion and unbalanced forces that change motion.** [Clarification Statement: An example is pushing on one side of a box can make it start sliding and pushing on a box from both sides, with equal forces, will not produce any motion at all.] [Assessment Boundary: Limit testing to one variable at a time: number, size, or direction of forces. The size and direction of forces should be qualitative. Gravity is only to be addressed as a force that pulls objects down.]

3-PS2-b. **Investigate the motion of objects to determine when a consistent pattern can be observed and used to predict future motions in the system.** [Clarification Statement: An example of motion with a predictable pattern is a child swinging in a swing. In this example, the student could observe the swing moving at different relative rates depending on where it is in the arc of the swing.]

3-PS2-c. **Investigate the effect of electric and magnetic forces between objects not in contact with each other and use the observations to describe their relationships.** [Clarification Statement: An example of an electric force could be the force on hair from an electrically charged balloon; an example of a magnetic force could be the force between two magnets. Cause and effect relationships include how the distance between objects affects strength of the force and how the orientation of magnets affects the direction of the magnetic force.] [Assessment Boundary: Limited to forces produced by objects that can be manipulated by students.]

3-PS2-d. **Apply scientific knowledge to design and refine solutions to a problem by using the properties of magnets and the forces between them.*** [Clarification Statement: Example problems include constructing a latch to keep a door shut, or creating a device to keep two moving objects from touching each other. Students should understand that the results of investigations about non-contact forces inform design solutions.]

Science and Engineering Practices

Asking Questions and Defining Problems
Asking questions and defining problems in grades 3–5 builds from grades K–2 experiences and progresses to specifying qualitative relationships.
- Formulate questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. (3-PS2-b),(3-PS2-a),(3-PS2-c)

Planning and Carrying Out Investigations
Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.
- Design and conduct investigations collaboratively, using fair tests in which variables are controlled and the number of trials considered. (3-PS2-a)
- Make observations and/or measurements, collect appropriate data, and identify patterns that provide evidence for an explanation of a phenomenon or test a design solution. (3-PS2-b),(3-PS2-a),(3-PS2-c)

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 3–5 builds on prior experiences in K–2 and progresses to the use of evidence in constructing multiple explanations and designing multiple solutions.
- Apply scientific knowledge to solve design problems. (3-PS2-d)

Connections to Nature of Science

Scientific Investigations Use a Variety of Methods
- Science investigations use a variety of tools and techniques. (3-PS2-b),(3-PS2-a),(3-PS2-c)
- There is not one scientific method. (3-PS2-b),(3-PS2-a),(3-PS2-c)

Disciplinary Core Ideas

PS2.A: Forces and Motion
- Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (Boundary: Qualitative and conceptual, but not quantitative addition of forces are used at this level.) (3-PS2-a)
- The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. (Boundary: Technical terms, such as magnitude, velocity, momentum, and vector quantity, are not introduced at this level, but the concept that some quantities need both size and direction to be described is developed.) (3-PS2-b)

PS2.B: Types of Interactions
- Objects in contact exert forces on each other (friction, elastic pushes and pulls). (3-PS2-b)
- Electric, magnetic, and gravitational forces between a pair of objects do not require that the objects be in contact—for example, magnets push or pull at a distance. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other. (3-PS2-c),(3-PS2-d)

PS2.C: Stability and Instability in Physical Systems
- A system can change as it moves in one direction (e.g., a ball rolling down a hill), shift back and forth (e.g., a swinging pendulum), or go through cyclical patterns (e.g., day and night). (3-PS2-b)
- Examining how the forces on and within the system change as it moves can help explain a system's patterns of change. (3-PS2-a)
- A system can appear to be unchanging when processes within the system are going on at opposite but equal rates. (3-PS2-a)

Crosscutting Concepts

Cause and Effect
- Cause and effect relationships are routinely identified, tested, and used to explain change. (3-PS2-a),(3-PS2-c)

Stability and Change
- Change is measured in terms of differences over time and may occur at different rates. (3-PS2-b)

Connections to Engineering, Technology, and Applications of Science

Interdependence of Science, Engineering, and Technology
- Tools and instruments (e.g., rulers, balances, thermometers, graduated cylinders, telescopes, microscopes) are used in scientific exploration to gather data and help answer questions about the natural world. Engineering design can develop and improve such technologies. (3-PS2-d)
- Scientific discoveries about the natural world can often lead to new and improved technologies, which are developed through the engineering design process. (3-PS2-d)

Connections to Nature of Science

Scientific Knowledge Assumes an Order and Consistency in Natural Systems
- Science assumes consistent patterns in natural systems. (3-PS2-b)

Connections to other DCIs in this grade-level: will be added in future version.

Articulation of DCIs across grade-levels: will be added in future version.

Common Core State Standards Connections:

ELA/Literacy –

RI.3.5 Use text features and search tools (e.g., key words, sidebars, hyperlinks) to locate information relevant to a given topic efficiently. (3-PS2-d)

RI.3.10 By the end of the year, read and comprehend informational texts, including history/social studies, science, and technical texts, at the high end of the grades 2–3 text. (3-PS2-b),(3-PS2-a),(3-PS2-c)

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SL.3.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 3 topics and texts, building on others' ideas and expressing their own clearly. (3-PS2-b),(3-PS2-a),(3-PS2-c)

Mathematics –

MP.1 Make sense of problems and persevere in solving them. (3-PS2-d)

MP.3 Construct viable arguments and critique the reasoning of others. (3-PS2-a)

MP.7 Look for and make use of structure. (3-PS2-b)

3.MD.2 Measure and estimate liquid volumes and masses of objects using standard units of grams (g), kilograms (kg), and liters (l). Add, subtract, multiply, or divide to solve one-step word problems involving masses or volumes that are given in the same units, e.g., by using drawings (such as a beaker with a measurement scale) to represent the problem. *(3-PS2-b),(3-PS2-a)*

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Connections to Engineering, Technology and Applications of Science

These connections are drawn from the disciplinary core ideas for engineering, technology, and applications of science in the *Framework*.

Connections to Nature of Science

Connections are listed in either the practices or the crosscutting connections section of the foundation box.

Supporting Materials

- Appendices have been added to support the NGSS and in response to feedback
  - Appendix A – Conceptual Shifts
  - Appendix B – Responses to Public Feedback
  - Appendix C – College and Career Readiness
  - Appendix D – All Standards, All Students
  - Appendix E – Disciplinary Core Idea Progressions in the NGSS
  - Appendix F – Science and Engineering Practices in the NGSS
  - Appendix G – Crosscutting Concepts in the NGSS
  - Appendix H – Nature of Science
  - Appendix I – Engineering Design in the NGSS
  - Appendix J – Science, Technology, Society, and the Environment
  - Appendix K – Model Course Mapping in Middle and High School
  - Appendix L – Connections to Common Core State Standards in Mathematics
  - Appendix M – Connections to Common Core State Standards in ELA

- July 2013 – Science Leaders training in NGSS to serve as district trainers and ambassadors
- District Science Leaders Network – DSLN meets quarterly, continued support, $10 per meeting
- Oct. Training for district science leaders and teachers (2 -3 days)
- Dec. training for district science leaders and emerging leaders (2 days)
- I Create: Supporting After School Leaders in Implementing NGSS
- Parent Outreach
    - Helping parents understand the changes and ways they can support their children and teachers
- Science Safety Training
    - 2012-2013 training held
        - Plans for 2013-2014
            - Elementary Focus
            - Secondary Focus
            - After School Program

We are here to support you!

The Leadership Challenge

Teams get better when ordinary people enable those around them to achieve extra-ordinary things.

Barry Posner and Jim Kouzes

Model the Way: Find your voice, serve as a positive example

Inspire a Shared Vision: Imagine exciting and ennobling activities, enlist others in a common vision by appealing to shared aspirations

Challenge the Process: Search for opportunities by seeking innovative ways to change, grow and improve. Take risks by generating small wins and learning from mistakes

Enable Others to Act: foster collaboration by promoting cooperative goals and building trust. Strengthen others by sharing power and discretion

Encourage the Heart: recognize contributions by showing appreciation for efforts. Celebrate the values and victories by creating a spirit of community.